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EFFECT OF PARALLEL MISALIGNMENT IN ROTATING MACHINERY Mr. Bhawthankar A. A1, Mr. Mane M. B2, Mr. Phopale Y. A3 Mr. Korshetti V. V4

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Abstract:

Misalignment of shaft in rotating systems is one of the most common faults. Improper aligning of shafts through couplings often leads to severe vibration problems in many rotating machines. Vibration monitoring is a useful technique which provides valuable information regarding symptoms of machinery failures, and in turn may avoid costly breakdowns. In the present paper experiment investigation of parallel misalignment in rotating machinery is presented.

1.0 INTRODUCTION

Recent trends in design of rotating machinery towards higher speeds, leads to manufacturers tending to produce machines which operate closer to lateral critical speeds. Consequently, the important consideration for rotor bearing system is the effect of coupling critical speeds and its misalignment on vibration amplitudes of such machines. Perfect alignment of the driving and driven shafts cannot be achieved in practical applications. Thus, a misalignment condition is virtually always present in machine trains. There is a growing tendency to extract information about the prognostic parameter based on system analysis through various diagnostics techniques, so as to assess the health of the plant or equipment. Vibration monitoring helps in identifying the early failure and hence in reducing the machine down time. The objective of vibration monitoring is to provide valuable information for the diagnosis of symptoms that help in maintenance planning. A vibration signature measured at the external surface of machine or at any other suitable place contains a good amount of information to reveal the running condition of the machine. Thus, it provides very useful information regarding symptom of machinery failure and hence in preventing costly breakdown.

Many researchers have studied techniques of faults diagnosis and analysis of resulting vibration signature related to misalignment and some of them are listed here. M.Xu and Marangoni[1] have developed a theoretical model of a complete motor-flexible-coupling-rotor system using the component mode synthesis. The universal joint effect was included in the model to take the misalignment effect into account. Mathematical model developed for a system under misalignment and unbalance condition and the derived equation indicates that, forcing frequency due to shaft misalignment are even multiple frequencies of the motor rotational speed.

M.Xu and Marangoni[2] have performed an experimental study on rotor dynamic test apparatus to verify the results of their earlier theoretical model. A self-designed flexible coupling and a commercial helical coupling were used in the experiments. The rotor shaft displacements were measured under different misalignment and unbalance condition. They concluded that theoretical predictions were in good agreement with experimental results. A.S.Sekhar and B.S.Prabhu[3] have developed a higher order FEM model for a rotor-coupling-bearing system and incorporated the coupling misalignment reaction forces and moments for both parallel and angular misalignments of a hypothetical rotor. The effects of these misalignments on the vibration response clearly show the characteristic signature of misaligned shafts.

K.M.Al-Hussain and I. Redmond[4] obtained the equation of motion using Lagrange's through successive partial differentiation of energy equation for two rotor subjected to purely parallel misalignment. Lateral and torsional

frequencies are excited during the transient and steady state condition and its steady state spectra revels the effect of parallel misalignment. In the present paper the effect of parallel misalignment through experimental study is attempted and presented here.

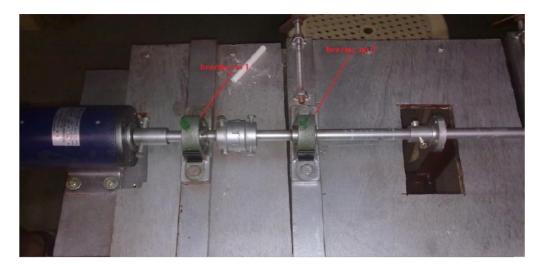
2.0 EXPERIMENTAL SETUP

The experimental setup developed for the study of effect of parallel misalignment is as shown in fig 2.1. It consists of a

d.c motor, a jaw coupling, deep groove ball bearings and their housing and a single disk rotor. The rotor shaft has a length of 400 mm with a bearing span of 300mm. The provision is made to create parallel and angular misalignment by shifting two bearing mountings parallel and keeping one at same location another one to be shifted respectively. The rotor shaft driven by 0.25 HP d.c motor. A d.c/a.c voltage controller is used to vary the voltage and to adjust motor power supply and due to this, the motor speed can be continuously increased or decreased in the range of 0 to 1500 rpm.

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Figure 2.1 Experimental setup



The bearing locations are identified for vibration measurement for the analysis purpose. Triaxial accelerometers are selected for measurement and vibration analysis is carried out by using a four channel FFT analyzer.

In order to study the effect of shaft misalignment initially the shafts must be aligned. The aligned system is used as an ideal case, for studying the effect of shaft misalignment by comparing the results. The parallel misalignment is created by shifting two bearing location equally in horizontal plane. Similarly angular misalignment is created out by shifting only the extreme dead end bearing in horizontal plane. The vibration readings or vibration spectra can be obtained for both aligned shaft and misaligned cases comparative study is to be carried out.

3.0 RESULTS AND DISCUSSION:

Initially both the shafts are properly aligned which is treated as ideal case and vibration spectra for the same is obtained and shown in figure 3.1. Vibration spectra show very low amplitude in both y and z direction and no sign of peak amplitude indicates that shaft are aligned.

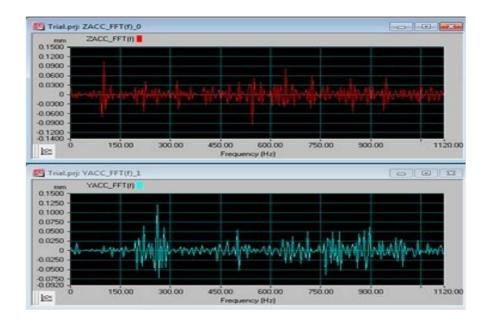


3.1 Vibration spectra for aligned system

As discussed in earlier section, parallel misalignment is created and for the same vibration spectra is acquired and is shown in figure 3.2. Vibration spectra show

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that increase in amplitude in axial direction is more than radial direction it indicates that parallel misalignment is present in the system



4.0 CONCLUSION:

Misalignments in rotating machinery can generate bearing forces and excessive vibrations due to which machine can fail. The Bearing housing forces are directly proportional to the type and level of misalignments. The present study shows that parallel misalignment can be identified from the vibration spectra analysis of experimental setup or machine which is very much useful in minimizing the vibration level due to misalignment by analyzing the systems properly.

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